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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/754,926	01/04/2001	Kie Y. Ahn	M122-1533	3846

21567 7590 10/07/2002

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EXAMINER	
KIELIN, ERIK J	
ART UNIT	PAPER NUMBER
2813	15

DATE MAILED: 10/07/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No. 09/754,926	Applicant(s) AHN ET AL.	
	Examin r Erik Kielin	Art Unit 2813	

-- The MAILING DATE of this communication app ars on the cov r sheet with the correspondence addr ss --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 19 August 2002.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 2-10 and 30-32 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 2-10 and 30-32 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 11.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 19 August 2002 has been entered.

Drawings

2. The corrected or substitute drawings were received on 19 August 2002. These drawings are acceptable.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims **10**, 2, 4-8, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,923,056 (**Lee** et al.) in view of the basic text of **Vossen and Kern**, <u>Thin Film Processes II</u>, Academic Press: Boston, 1991, pp. 80-81, 108-109, 113-115, 188, 200.

Regarding independent claim **10**, **Lee** discloses forming a variety of semiconductor devices including MOS, flash EPROM, capacitors, DRAMs, etcetera having a doped metal oxide, which may be a silicon-doped aluminum oxide (col. 1, line 66 to col. 2, line 10; col. 3, lines 19-40). An **example** is disclosed (cols. 5-6, "EXAMPLE 1") wherein the silicon-doped aluminum oxide is formed by sputtering from a target containing aluminum with 1% silicon using sputtering (i.e. co-evaporating silicon and aluminum) in a chamber having argon and oxygen wherein evaporation is generated by glow discharge plasma. **Lee** discloses the "conductive material" (called the "gate 13" in **Lee**) on the deposited silicon-doped aluminum oxide (called "gate dielectric 18" in **Lee**). Note that silicon is semiconductive.

Lee does not disclose that specifically silicon monoxide and aluminum oxide are co-evaporated, but does expressly state that the doped metal oxide films may be formed using "a conventional deposition technique such as sputtering ..." (col. 2, lines 15-21).

The basic textbook of **Vossen and Kern** teaches conventional techniques for forming thin films including forming a mixed or alloy film using "two-source sputtering, with one source for one alloy component and the other source for the second component." (See p. 200, section entitled "*Targets.*") **Vossen and Kern** also teaches numerous examples of mixed films formed using separate evaporative sources on p. 108-109, Table II. Sources for aluminum oxide (Al_2O_3) and SiO are also taught to be known on pp. 113-115, Table III as well as the composition of the vapor upon evaporation. Note also that even if SiO_2 is used as the evaporative source, that **SiO is the main component of the vapor -- not SiO_2**. So even if SiO_2 is thermally evaporated, SiO is the vapor species formed.

It would have been obvious to one of ordinary skill at the time of the invention to use a silicon monoxide source and an aluminum oxide source to form a silicon doped aluminum oxide film as a matter of design choice because it appears that the choice of SiO and Al_2O_3 sources are well known and will result is the same silicon-doped aluminum oxide as that disclosed in **Lee**, and because **Lee** teaches "a conventional deposition technique such as sputtering" will work and because the use of separate sources to form a mixed or alloy layer is conventional, as taught by **Vossen and Kern**.

Applicant could overcome the rejection by providing evidence that the specific use of silicon monoxide and aluminum oxide provides unexpected results in the Si-doped aluminum oxide film relative to that source used in **Lee**. Presently there is no such evidence of record.

Regarding claim 2, the omission of O_2 is obvious since the oxygen component is already provided in the known SiO and Al_2O_3 sources. One of ordinary skill would be motivated to leave out the oxygen since it is already provided in the sources used.

Regarding claims 4, **Vossen and Kern** also teach thermal evaporative systems for SiO (silicon monoxide) at pp. 98-99, especially Fig. 9, are conventional. It would have been obvious to one of ordinary skill at the time of the invention to use thermal evaporation of SiO, as a matter of design choice since **Lee** teaches conventional deposition methods apply and because **Vossen and Kern** teaches thermal evaporation specifically of SiO is conventional.

Regarding claims 5 and 6, **Vossen and Kern** teach that thermal evaporation is conventionally carried out using, *inter alia*, electron beams (guns) (pp. 80-81), and that ion beams are conventionally used for sputter deposition (p. 188). It would have been obvious to one of ordinary skill at the time of the invention to use electron beam or ion beam sputtering of Al_2O_3

by an electron beam, as a matter of design choice since **Lee** teaches conventional deposition methods apply and because **Vossen and Kern** teach that electron and ion beams are conventional for deposition of thin films.

Regarding claim 7, the specific combination of thermal evaporation of SiO and "one or both of electron gun evaporation and ion beam evaporation" of Al_2O_3 is also a matter of design choice for the reasons indicated above -- especially since electron gun is just an example of a thermal evaporation method, as taught by **Vossen and Kern**.

Regarding claim 8, **Lee** discloses the silicon substrate (col. 5, line 56).

Regarding claim 30, **Vossen and Kern** teaches that SiO is the evaporated species for both SiO and SiO_2 targets (p. 114, Table III). So it is seen to be inherent in the method of **Lee** in view of **Vossen and Kern** that SiO is evaporated from the SiO source.

Regarding claim 31, **Lee** specifically states that the dopant is 0.1 to 30 weight percent of the dielectric film. (See Abstract.)

Regarding claim 32, **Lee** teaches an exemplary embodiment where the substrate temperature is 380 °C.

Vossen and Kern teach several examples of forming doped metal oxides using and SiO target, for example, wherein the temperature range of the substrate is 25-300 °C. (See Table II.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to deposit the silicon-doped aluminum oxide of **Lee** at room temperature, because **Lee** teaches conventional sputtering methods may be used and **Vossen and Kern** teaches that sputtering at room temperature is conventional for doped oxide formation. Furthermore, it would be a matter of routine optimization to sputter deposit the silicon-doped aluminum oxide at room temperature

because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. See *In re Jones,* 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and *In re Boesch*, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). One of ordinary skill would be especially motivated to use room temperature since **Vossen and Kern** teach that this temperature is conventional and in order to reduce the thermal budget which enables the production of smaller device features.

5. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Lee** in view of **Vossen and Kern** as applied to claim 1 above, and further in view of JP 60-167352 A **(Fujisada)**.

The prior art of **Lee** in view of **Vossen and Kern**, as explained above, teaches all of the features of the claims except for using a sapphire source for the aluminum oxide.

Fujisada teaches the benefits of preventing injurious impurities from being incorporated into sputter-deposited aluminum oxide films by using a sapphire target, specifically for use in semiconductor device applications. (See Abstract.)

It would have been obvious to one of ordinary skill at the time of the invention to use a sapphire source as the aluminum oxide source in the method of **Lee** in view of **Vossen and Kern** to prevent contamination of the deposited film, as taught by **Fujisada**.

6. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Lee** in view of **Vossen and Kern** as applied to claim **10**, above, and further in view of **Wolf**, Silicon Processing for the VLSI Era, Vol. 1 : Process Technology, Lattice Press: Sunset Beach, CA 1986, p. 5.

Lee does not specifically state that the silicon substrate is "monocrystalline."

Wolf teaches that integrated circuits are formed on monocrystalline or "single crystal" silicon substrates (p. 5, first paragraph under section entitled "Manufacture of Single Crystal Silicon.")

It would have been obvious to one of ordinary skill at the time of the invention to use the notoriously well-known monocrystalline substrates, as **Wolf** teaches that monocrystalline is always used over other forms of silicon to enable sufficient carrier lifetime in semiconductor devices.

Response to Arguments

7. Applicant's arguments filed 19 August 02 (Paper No. 14) have been fully considered but they are not persuasive.

On p. 4, last sentence, Applicant argues that Vossen does not disclose co-evaporation of aluminum oxide and silicon monoxide. Examienr respectfully disagrees for the reasons indicated above and as provided in the previous action (Paper No. 10, filed 5/20/02) in the section entitled, "***Response to Arguments***" which are incorporated here in their entirety. Note that "[I]n considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom." *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA

1968) See also *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976). Such is the case in **Vossen and Kern** as applied to **Lee**.

As restated from the pervious action (ibid.): **Lee** suggests using a conventional technique, which a suggestion that the exemplary embodiment is not limiting to the method of deposition and motivates one of ordinary skill to use any conventional sputtering method -- not just the exemplary one included in **Lee**. The general textbook of **Vossen and Kern** goes to provide proof of what is generally known to one of ordinary skill. Since **Vossen and Kern** specifically teaches that it is known to use at least two targets of different materials to form a deposited layer whose composition is a mixture of the materials from the targets, one expressly knows from such teaching that, if a silicon-aluminum oxide is to be formed that this may be formed by any targets containing silicon, aluminum, or oxygen, merely by common sense.

Applicant also appears to argue that the specific targets SiO and Al_2O_3 to form a silicon-aluminum oxide must somehow expressly be shown in order to provide the suggestion to use such a combination. For the reasons just indicated, Examiner respectfully disagrees that such suggestion is the only such suggestion leading one of ordinary skill to the desired layer. Rather, the common sense suggestion provided by **Vossen and Kern** is sufficient to suggest one of ordinary skill specifically what materials must appear in the targets used to form a given layer -- specifically that each of the elements in the layer may be present. In the instant case these elements are Al, Si, and O. By the text of **Vossen and Kern**, the express suggestions are to use any of the following targets: (1) a single target containing Si, Al, and O (e.g. aluminosilicate); (2) a first target using Si and a second having Al and O; (2) a first target containing Si and O and a second containing Al; (3) a first target containing Si and O (e.g. SiO or SiO_2) and a second target

containing Al and O (e.g. Al_2O_3); or (4) separate Si and Al targets or a combined SiAl target used while reactive sputtering in an O-containing atmosphere. This is the common sense suggestion of the text of **Vossen and Kern**.

Applicant argues on p. 5 that "since the present claims are method claims, the present rejection would be overcome by advantages afforded by the recited features upon the method." While not commenting on the validity of Applicant's statement, Examiner notes that such is not the case when such teachings are obvious to one of ordinary skill, which has been demonstrated. Accordingly, it is the unexpected **result** that is required to be shown by Applicant, since the method is, in fact, obvious to one of ordinary skill. Applicant has not provided evidence to suggest that the specific combination of targets of specifically SiO and Al_2O_3 produce an unexpected result in the resulting Si-Al oxide layer produced. Accordingly, it would appear that Applicant has acquiesced, thereby suggesting that there exists no unexpected results. Evidence is especially required since **Vossen and Kern** expressly indicates that the main gaseous component in a vapor produced from a SiO_2 target is SiO, which is Applicant desired gaseous species. For at least this reason, the resulting silicon-aluminum oxide arising from a conventional SiO target or and SiO_2 target, either combined with an Al_2O_3 target by co-evaporation/co-sputtering would be expected to have the same properties.

It is not Office policy to assume unexpected results exist. Rather, Applicant has the burden of proof. Also note that arguments presented by Applicant's Representative are insufficient where evidence is required. (See MPEP 2145.)

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The article **Manchanda** et al. "Gate quality doped high K films for CMOS beyond 100 nm: 3-10 nm Al_2O_3 with low leakage and low interface states," IEDM 1998, 6-9 December 1998, pp. 605-608, discloses the use of silicon-doped aluminum oxide for semiconductor device applications.

US 6,300,202 B1 (**Hobbs** et al.) teaches the use of silicon-doped aluminum oxide for semiconductor device applications (col. 2, lines 48-65).

US 6,280,810 B1 (**Nakamura** et al.) teaches co-sputtering of, *inter alia*, SiO and Al_2O_3 to form protective films (col. 4, lines 49-64).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Erik Kielin

Erik Kielin
October 5, 2002